Original Article

A 10-Year Profile of Trauma Admissions Caused by Interpersonal Violence: A Major Trauma Centre's Experience

Kai Xiong Cheong, [1] *MBBS, DFD (CAW)*, Hong Yee Lo, [1] *MBBS, FRCS*, Li Tserng Teo, [1] *MBBS, FRCS, FAMS*, Crystal A Raphael, [2], Karen TS Go, [2], Vijayan Appasamy, [1] *MBBS, FRCS, FAMS*, Ming Terk Chiu, [1] *MBBS, FRCS, FAMS*

Abstract

Introduction: This study aimed to characterise interpersonal violence victims admitted to a major trauma centre. **Materials and Methods:** A retrospective cohort study of interpersonal violence victims who were admitted to our centre from 1 January 2001 to 31 December 2010 was conducted. Data were obtained from our trauma registry. **Results:** Interpersonal violence victims constituted 444 (90.1% males and 9.9% females) out of a total of 8561 trauma admissions in the same time period. The average age was 36.6 years (range, 14 to 83 years). Majority were Chinese (53.4%) and Singaporeans (77.3%). The number of cases increased from 10 per year to 96 per year in the first 8 years, then decreased in the last 2 years (55 in year 2010). Time of injury was predominantly 0000 to 0559 hours (72.3%). Interpersonal violence mostly occurred in public spaces for both genders (88.7%). However, the number of females who were injured at home was significantly higher than males ($P = 0.000$). Blunt trauma (58.3%) was more common than penetrating trauma (41.7%). The average injury severity score (ISS) was 13.5 (range, 1 to 75); 34.9% of patients had major trauma (ISS >15). The average Glasgow coma scale (GCS) score was 13.5 (range, 3 to 15); 16.4% of patients had moderate-to-severe brain injury (GCS 3-8). Blunt trauma was significantly more likely to cause major trauma than penetrating trauma ($P = 0.003$). The sole case of firearm assault caused most morbi-mortality. Overall mortality was 4.5%. Major trauma (OR: 25.856; $P = 0.002$) and moderate-to-severe brain injury (OR: 7.495; $P = 0.000$) were independent risk factors of mortality. **Conclusion:** There has been no prior published data on interpersonal violence locally. This study is thus useful as preliminary data for future population-based studies. It also provides data for authorities to formulate preventive and intervention strategies.

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Key words: Demographics, Glasgow coma scale, Injury severity score, Mortality

Introduction

The World Health Organization (WHO) has divided violence into 3 categories: interpersonal violence, self-directed violence, and collective violence. Violence is defined as "the intentional use of physical force or power, threatened or actual, against oneself, another person, or against a group or community, that either results in or has a high likelihood of resulting in injury, death, psychological harm, maldevelopment or deprivation."[1] Interpersonal violence can be categorised into violence against family (victimisation of the elderly, children, spouse, siblings, parents, etc.), and violence against members of the community who may be acquaintances or strangers (workplace assault, rape, assaults, etc.).[2] Globally, it accounts for 10% of deaths, which translates to about half

a million deaths a year.[3] In Singapore, about 5000 cases are recorded by the Singapore Police Force annually.[4]

Traditionally, police records and crime surveys serve as sources of information regarding interpersonal violence. Although they are good indications of the incidence of interpersonal violence, they are poor measures of the severity of the injuries sustained and the outcomes of the victims. In contrast, hospital data from trauma registries are good measures of harm and patient outcomes, because information about the violence can be prospectively acquired from the victims simultaneously with their management. Nonetheless, studies which use hospital data to characterise interpersonal violence tend to be region-specific due to differences in socio-politico-economic circumstances

[1]Trauma Service, Department of General Surgery, Tan Tock Seng Hospital, Singapore
[2]Trauma Service, Tan Tock Seng Hospital, Singapore
Address for Correspondence: Dr Cheong Kai Xiong, Trauma Service, Department of General Surgery, Tan Tock Seng Hospital, 11 Jalan Tan Tock Seng, Singapore 308433.
Email: kaixiong.cheong@gmail.com

amongst regions.[5-11] There remains a lack of similar data specific to Singapore, which has made it difficult to develop evidence-based and appropriate intervention and prevention strategies. Hence, this paper attempts to characterise the epidemiology, circumstances and characteristics of injury, and outcomes of patients who were admitted to the Tan Tock Seng Hospital (TTSH) over a 10-year period from 1 January 2001 to 31 December 2010 with injuries caused by interpersonal violence.

Materials and Methods

Study Population

All interpersonal violence victims who had injury severity scores (ISS) of ≥9 and who were admitted to the TTSH High Dependency Unit or Intensive Care Unit from 1 January 2001 to 31 December 2010 were studied. A person is defined as a victim of interpersonal violence if his or her principal diagnosis was injury that was caused by another person, as designated by the International Classification of Disease (ICD) Tenth Revision Version for 2010, Chapter XX External Causes of Morbidity and Mortality, Assault codes (X85 to Y09).[12] A retrospective cohort study was performed.

Data Collection

Information regarding patient demographics, circumstances of injury, characteristics of injury, and outcomes were collected from the trauma registry, which is a prospectively maintained database managed by our centre's Trauma Service.

Definitions

The causes of injury were categorised by the ICD into: (i) Assault by sharp objects (X99), (ii) Assault by blunt objects (Y00), (iii) Assault by bodily force (Y04), (iv) Assault by firearms (X93, X94, X95), (v) Sexual assault by bodily force (Y05), (vi) Maltreatment, which includes, but not limited to neglect, abandonment, torture, and abuse (Y06.0 – Y06.9, Y07.0 – Y07.9), and (vii) Other methods (all other codes between X85 and Y09).[12]

The pre-hospital time interval for patients who arrived via ambulance is defined as the elapsed time from the time of call for the ambulance to the time of arrival of the patient at our centre's Accident and Emergency (A&E) department. Major trauma was defined as an ISS of 16 and above.[13] Severe, moderate and mild brain injuries were defined as Glasgow Coma Scale (GCS) scores of 3 to 8, 9 to 12, and 13 to 15 respectively.[14]

Data Analysis

The data were analysed using IBM SPSS Statistics for Windows, Version 19.0 (IBM, Chicago, IL). The means, standard deviations, ranges, and medians were reported for categorical variables where appropriate, and the numbers and individual percentages were reported for categorical variables. Normality of quantitative data was checked for using the Quantile-Quantile plot. Differences between groups were tested using the Pearson's chi-Squared Test, the Fisher's Exact Test, the Independent T-Test, and the One-way Analysis of Variance Test where appropriate. A multiple logistic regression analysis was performed to identify significant factors of mortality.

Results

Overall

Interpersonal violence victims constituted 444 (90.1% males; 9.9% females) out of a total of 8561 trauma admissions in the same time period. There was a steady increase in the number of interpersonal violence admissions from 10 cases in 2001 to a peak of 96 cases in 2008. This was followed by a decrease from 2008 to 2010 (55 cases in 2010) (Fig. 1). There was an average of 3 to 4 admissions every month. There was no seasonality in the distribution of admissions.
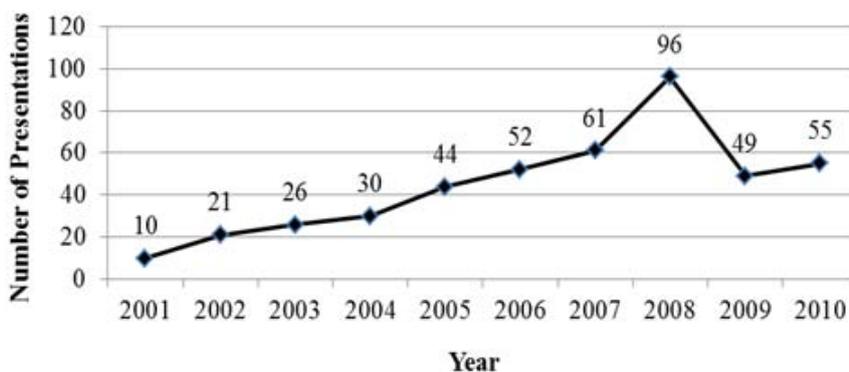

Fig. 1. Graph showing the number of interpersonal violence presentations in the years 2001 to 2010.

Demographics

There were 400 males (90.1%) and 44 females (9.9%). The average age was 36.6 years (median: 36.0 years; range, 14 to 83 years); 46.8% of the patients were between 20 and 39 years of age. The distribution of patients across all age groups for both genders was similar. The Chinese accounted for the majority of patients (53.4%), whereas Indians and Malays constituted 17.1% and 20.7% of the patient population respectively. The majority of the patients were Singaporeans (77.3%) (Table 1).

Table 1. Demographics of Patients

Demographics	Number (%)
Gender	
Male	400 (90.1)
Female	44 (9.9)
Age (years)	
0 to 19	46 (10.4)
20 to 39	208 (46.8)
40 to 59	163 (36.7)
60 to 79	25 (5.6)
80 to 100	2 (0.5)
Ethnic Group	
Chinese	237 (53.4)
Malay	92 (20.7)
Indian	76 (17.1)
Minority	39 (8.8)
Nationality	
Singaporean	343 (77.3)
Malaysian	19 (4.3)
Indian National	16 (3.6)
Chinese National	15 (3.4)
Others*	51 (11.5)

*Includes Thai, Bangladeshi, Nepalese, Burmese, Indonesian, Vietnamese, American, British and European

Table 2. Circumstances of Injury (Univariate Analysis)

	Male (%)	Female (%)	*P* value
Time (hours)			NS
0000 to 0559	293 (73.3)	28 (63.6)	
0600 to 1159	19 (4.8)	5 (11.4)	
1200 to 1759	24 (6.0)	2 (4.5)	
1800 to 2359	64 (16.0)	9 (20.5)	
Place of Occurrence			0.000
Public Area	373 (93.3)	28 (63.6)	
Home	14 (3.5)	15 (34.1)	
Institution*	13 (3.3)	1 (2.3)	

P values in bold are statistically significant.

*Includes workplaces, nursing home, and the Institute of Mental Health (IMH)

Time of Injury

The time of injury was predominantly from 0000 to 0559 hours (72.3%). There was no significant difference in the time of injury between the genders (Table 2).

Places Where the Interpersonal Violence Events Occurred

The most common place where interpersonal violence events occurred was public spaces (88.7%). This was common to both genders. However, the number of females who were injured at home (34.1%) was significantly higher compared to males (3.5%) ($P = 0.000$) (Table 2). The age of the female victims who were injured at home was 40.0±14.8 years (range, 18 to 65 years). For these victims, injury was caused by the use of bodily force two-thirds of the time.

Mode of Arrival at the A&E Department

The majority of patients (338) arrived via ambulance (76.1%). One patient arrived via air transport (0.2%). The remaining 105 patients arrived via their own means (23.6%).

Pre-Hospital Time Interval

The average pre-hospital time interval for patients who arrived via ambulance was 36.0 ± 13.0 minutes (median: 36.0 minutes; range, 16.0 to 91.0 minutes). The pre-hospital time interval for the majority of the patients (312 patients, 70.3%) was up to 60.0 minutes.

Types of Trauma

Blunt trauma (58.3%) was more common than penetrating trauma (41.7%) (Table 3).

Causes of Injury

Assault by sharp objects was the most single most common cause of injury (48.6%). Only 1 case of firearm assault was reported (0.2%). No patient was injured by sexual assault by bodily force, or maltreatment. A variety of sharp and blunt objects used in the attacks was described. Sharp objects included knives, scissors, blades, and broken glass bottles. Blunt objects included beer mugs, bottles, hammers, hoes (changkols), crowbars, and golf clubs. For assault by bodily force, injury was caused almost entirely by the fist

Table 3. Types of Trauma

Type	Number (%)
Penetrating	185 (41.7)
Blunt	259 (58.3)

Table 4. Causes of Injury

Cause	Number (%)
Sharp Object*	216 (48.6)
Blunt Object†	133 (30.0)
Bodily Force	75 (16.9)
Firearm	1 (0.2)
Other Methods‡	19 (4.3)

*Includes knives, scissors, blades and broken glass bottles.
†Includes beer mugs, bottles, hammers, hoes (changkols), crowbars and golf clubs.
‡Mostly unspecified; 1 patient was reportedly dragged along the road by robbers who were on motorcycles.

Table 5. Severity of Trauma (Univariate Analysis)

	Male (%)	Female (%)	*P* value
Total	289 (65.1)	155 (34.9)	
Severity of Injury	8.7 ± 3.2	22.3 ± 7.4	0.000*
Gender			NS
Male	257 (64.3)	143 (35.8)	
Female	32 (72.7)	12 (27.3)	
Age	36.6 ± 13.8	36.8 ± 15.0	NS
Type of Trauma			0.003*
Penetrating	135 (73.0)	50 (27.0)	
Blunt	154 (59.5)	105 (40.5)	
Cause of Injury			0.003*
Sharp Object	157 (72.7)	59 (27.3)	
Blunt Object	81 (60.9)	52 (39.1)	
Bodily Force	44 (58.7)	31 (41.3)	
Firearm	0 (0.0)	1 (100.0)	
Other Methods	7 (36.8)	12 (63.2)	

*Statistically significant on univariate analysis.

blows and/or kicks, and 1 patient was pushed into the drain. Assault by other methods was mostly unspecified, except for 1 patient who was reportedly dragged along the road by robbers who were on motorcycles (Table 4).

Severity of Trauma

The overall average ISS was 13.5 (median: 10; range, 1 to 75). One hundred fifty-five patients had major trauma (34.9%), i.e. ISS of >15. The average ISS of patients with major trauma (22.3) was significantly higher than that of patients with non-major trauma (8.7) ($P = 0.000$). Blunt trauma was significantly more likely to result in major trauma than penetrating trauma ($P = 0.003$). The cause of injury was significantly associated with the severity of trauma ($P = 0.003$). Although sharp objects was the most common cause of injury, they were the least likely to result in severe injuries. In contrast, the sole case of firearm assault resulted in major trauma (Table 5).

Table 6. Severity of Brain Injury (Univariate Analysis)

	Mild (%)	Moderate (%)	Severe (%)	*P* value
Total	371 (83.6)	24 (5.4)	49 (11.0)	
Severity of Injury	14.8 ± 0.4	10.4 ± 1.2	5.1 ± 2.1	0.000*
Gender				NS
Male	334 (83.5)	21 (5.3)	45 (11.3)	
Female	37 (84.1)	3 (6.8)	4 (9.1)	
Age (years)	36.3 ± 14.3	37.6 ± 12.0	38.8 ± 14.6	NS
Cause of Injury				0.000*
Sharp Object	188 (87.0)	7 (3.2)	21 (9.7)	
Blunt Object	103 (77.4)	11 (8.3)	19 (14.3)	
Bodily Force	69 (92.0)	4 (5.3)	2 (2.7)	
Firearm	0 (0.0)	0 (0.0)	1 (100.0)	
Other Methods	11 (57.9)	2 (10.5)	6 (31.6)	
Mode of Arrival				0.000*
Paramedic Transport	268 (79.1)	22 (6.5)	49 (14.5)	
Self	103 (98.1)	2 (1.9)	0 (0.0)	

*Statistically significant on univariate analysis.

Severity of Brain Injury

The overall average GCS score was 13.5 (median: 15; range, 3 to 15). Seventy-three patients had moderate-to-severe brain injury (16.4%), i.e. GCS 3-12. The average GCS score of patients with severe brain injury (5.1) was significantly lower than that of patients with moderate brain injury (10.4), and both were in turn significantly lower than that of patients with mild brain injury (14.8) (P = 0.000). The cause of injury was significantly associated with the severity of brain injury (P = 0.000). Bodily force produced the mildest brain injury. In contrast, the sole case of firearm assault resulted in severe brain injury. Patients who arrived via paramedic transport were significantly more likely to have moderate-to-severe brain injury (P = 0.000) (Table 6).

Mortality

The overall mortality rate was 4.5%. Six patients died in the A&E department. The other 14 patients were transferred to the other services before they eventually died from their injuries.

The gender, age, place of occurrence of interpersonal violence, type of trauma, and the pre-hospital time interval were not significantly associated with mortality in the univariate analysis. In contrast, the cause of injury, mode of arrival at the A&E department, severity of trauma, and the severity of brain injury were significantly associated with mortality in the univariate analysis.

Bodily force did not cause any mortality, whereas the sole case of firearm assault resulted in mortality. All of the patients who died had originally arrived at the A&E department via paramedic transport.

The average ISS of the 20 patients who died was 31.9 (median: 31; range, 16 to 75). The average ISS of the 6 patients who died in the A&E department was 39.0 (median: 34.5; range, 26 to 75). The average ISS of the 14 patients who eventually died in the other admitting services was 29.0 (median: 28.0; range, 14 to 43). The average ISS of the patients who died was higher than that of the 424 patients who survived, i.e. 12.6 (median: 10; range, 1 to 41).

The average GCS score of the 20 patients who died was 4.9 (median: 3; range, 3 to 14). The average GCS score of the 6 patients who died in the A&E department was 3.0 (median: 3.0; range, 3 to 3). The average GCS score of the 14 patients eventually died in the other admitting services was 5.7 (median: 3.5; range, 3 to 14). The average GCS score of the patients who died was lower than that of the remaining 424 patients who survived, i.e. 13.9 (median: 15.0; range, 3 to 15) (Table 7).

In the multiple logistic regression analysis, major trauma (OR: 25.856; P = 0.002) and moderate-to-severe brain injury (OR: 7.495; P = 0.000) were found to be independent risk factors of mortality (Table 8).

Table 7. Mortality (Univariate Analysis)

	Alive (%)	Dead (%)	*P* value
Total	424 (95.5)	20 (4.5)	
Gender			NS
Male	383 (95.8)	17 (4.3)	
Female	41 (93.2)	3 (6.8)	
Age (years)	36.5 ± 14.0	40.3 ± 17.1	NS
Place of Occurrence			NS
Home	28 (96.6)	1 (3.4)	
Outside Home	396 (95.4)	19 (4.6)	
Type of Trauma			NS
Penetrating	177 (95.7)	8 (4.3)	
Blunt	247 (95.4)	12 (4.6)	
Pre-Hospital Time Interval (min)			NS
	36.0 ± 11.0	40.0 ± 21.0	
Cause of Injury			0.000*
Sharp Object	208 (96.3)	8 (3.7)	
Blunt Object	125 (94.0)	8 (6.0)	
Bodily Force	75 (100.0)	0 (0.0)	
Firearm	0 (0.0)	1 (100.0)	
Other Methods	16 (84.2)	3 (15.8)	
Mode of Arrival			0.006*
Paramedic Transport	319 (94.1)	20 (5.9)	
Self	105 (100.0)	0 (0.0)	
Severity of Trauma			0.000*
Non-Major	288 (99.7)	1 (0.3)	
Major	136 (87.7)	19 (12.3)	
Severity of Brain Injury			0.000*
Mild	370 (99.7)	1 (0.3)	
Moderate-to-Severe	54 (74.0)	19 (26.0)	

*Statistically significant on univariate analysis.

Table 8. Multiple Logistic Regression Analysis of Factors which Influence Mortality

	Odds Ratio (95% CI)	*P* Value
Cause of Injury		NS
Firearm	1.148 (0.728, 1.811)†	
Non-Firearm (Reference)		
Mode of Arrival		NS
Paramedic Transport	1.257 (0.636, 1.819)†	
Self (Reference)		
Severity of Trauma		0.002*
Major	25.856 (3.203, 58.694)†	
Non-Major (Reference)		
Severity of Brain Injury		0.000*
Moderate-to-Severe	7.495 (3.374, 16.649)†	
Mild (Reference)		

*Statistically significant.
†Values in parentheses are the 2.5th and 97.5th of the 95% confidence intervals (i.e. 2.5% and 97.5%).

Discussion

Interpersonal violence remains relatively uncommon in Singapore. These 444 cases represent a very specific subset of the total of 8561 patients who were admitted to TTSH over the same time period for all forms of trauma, including vehicular accidents. This low prevalence can be accounted for by the strict laws in Singapore.

Nearly half of all victims (46.8%) were young, of age 20 to 39 years. This male predominance (90.1) may be attributed to the tendency for males to engage in violent behaviour or crime. This gender disproportion was also noted in other studies.[5,7-11] It was also noted that there were no significant differences in the severity of trauma, severity of brain injury and mortality between the genders.

Victims were mainly young adults and not adolescents (average: 36.6 years). Adults may be more likely to spend a greater proportion of their time in public spaces where there are higher risks of confrontation and interpersonal violence. It may also suggest that teenage violence is a less common cause of interpersonal violence in the hospital catchment area.

The Indians (20.7%), Malays (17.1%) and minor ethnic groups (8.8%) experienced a disproportionately higher burden of interpersonal violence compared to the Chinese. This is not in keeping with the respective proportions of Malays, Indians, and minor ethnic groups, who represented 13.9%, 7.9% and 1.4% of the population in 2000, and 13.4%, 9.2%, and 3.3% of the population in 2010.[15] Also, this study has demonstrated that the majority of the patients were actually Singaporeans (77.3%).

Interpersonal violence tended to happen between 1200 and 0600 hours in public spaces for both genders. Also, the number of females who were injured at home was disproportionately higher compared to males, which suggests that domestic violence is still a significant issue for females. These female victims represent a fairly wide age range from 18 to 65 years. Also, they tended to be injured by bodily force rather than sharp or blunt objects. The sub-analysis did not indicate disproportionate representation by any ethnic group for domestic violence. The reported rate in this study is likely to be an underestimation since it is well known that domestic violence victims often do not report to the authorities.[16]

Blunt trauma was more common, and was significantly more likely to cause major trauma than penetrating trauma. There was only 1 case of firearm assault in this study. Access to and use of firearms in Singapore is restricted to authorised members of the Police Force and the Armed Forces. Its use resulted in major trauma, severe brain injury, and mortality.

The pre-hospital time interval was 36.0 minutes for paramedic transport. This may not be fast enough depending on the injury severity. Keeping this time interval short is crucial because the lapse of critical time denies patients of timely management. However, there was no association between the pre-hospital time interval and mortality.

In total, 34.9% and 16.4% of the patients had major trauma and severe brain injury respectively. Their respective severities were not influenced by gender and age. The overall mortality rate was 4.5%, which is relatively low. Unsurprisingly, major trauma (OR:25.856; $P = 0.002$) and moderate-to-severe brain injury (OR:7.495; $P = 0.000$) were independent risk factors of mortality.

From here, it can be seen that a trauma registry is an essential component of any efficient trauma management system. The information can be analysed, and the findings can provide data for policy makers to formulate violence prevention and intervention programmes. An example of this could be the identification of domestic violence in the catchment area for TTSH. Within their own homes, it is difficult for law enforcers to bring to task perpetrators of domestic violence. However, softer approaches in the form of promoting awareness, befriender services, or even refuge/shelter facilities can be considered.

The main limitation of this study is that it is specific to a single centre. The Singapore Police Force reports approximately 5000 cases of interpersonal violence in Singapore annually. Given that a major trauma centre like the TTSH admits only about 40 of such cases every year, it is obvious that the majority are probably not seriously injured and do not get admitted to the hospitals. Hence, we may conclude that hospital-based data does not add very much to what we know about the incidence and prevalence of interpersonal violence. However, it remains a good measure of harm and patient outcomes. In support of this, there are recommendations which state that data from both health care and law enforcement systems must be considered simultaneously to evaluate violence burden judiciously.[17]

The data reported is only representative of the areas served by the hospital. Some of the trends described like the over-representation of certain ethnic groups, a decrease in the admission rates in the last 2 years of the study, and the low incidence of teenage violence may not be extrapolated to the entire country. In fact, external factors may have accounted for these trends, such as the opening of the Khoo Teck Puat Hospital could have led to a diversion of trauma cases, resulting in the drop in admissions to our centre. Teenage violence could also have been diverted to the women and children hospital. Nonetheless, TTSH is located at the intersection of 2 major expressways in Singapore, and serves a large catchment area in the central portion of the island, making these data representative of a significant subpopulation of the country.

Another limitation of this study is that it could not consider victims of interpersonal violence who did not seek treatment, who were treated by private doctors or other medical personnel, and who deliberately concealed the associations of their injuries with interpersonal violence. This may be particularly so in women and young children. Singapore is also a place where there are still strong social pressures to keep violence behind closed doors, and where, unfortunately, non-consensual sexual intercourse within marriage is yet to be considered as illegal under most circumstances. Taken together, it is reasonable to assume a certain degree of underreporting of interpersonal violence. Nonetheless, this study is still a good characterisation of interpersonal violence where moderate to severe trauma is concerned.

Conclusion

This study provides factual health data of interpersonal violence victims treated at a major trauma centre. While attempts were made to draw certain conclusions from these data, we recognise the limitation of data from a single institution. However, this limitation does highlight the paucity of national data in this area. There has been no prior published data on interpersonal violence locally. The National Trauma Registry is currently still in the early years of establishment. It is hoped that a matured national registry will provide even more compelling data for policy makers to formulate and implement preventive measures.

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